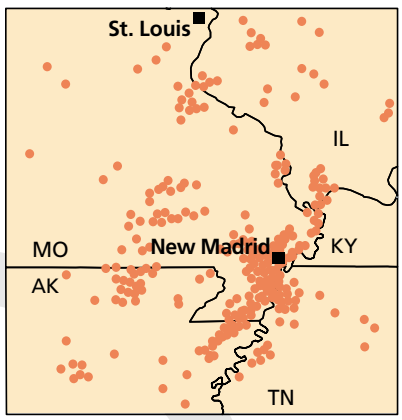
By Angela Wilson

Great Quakes!

A former MoDOT weigh-station site reveals surprising facts about New Madrid earthquakes

The sandy terrain of Southeast Missouri may not evoke the same images as the sands of ancient Egypt. But between 800 and 1100 years ago, the Bootheel was home to Native Americans who built flat-topped, pyramid-shaped mounds, whose remains, like the pyramids of the Pharaohs, are visible to this day.



New Madrid Earthquakes 1975-1995
Source: Saint Louis University Earthquake Center

Most archaeologists agree, sometime after 1400 a sudden and widespread event caused the settlers to abandon the "vacant quarter," the name archaeologists have given to the Mississippi River Valley from Cairo, Ill., to Mississippi County, Ark. Yet there has been little agreement about what exactly could have caused a thriving agricultural society to leave some of the best land in the region.

Possible answers are epidemic or war. However, evidence recently uncovered by the Missouri Department of Transportation's cultural resources team could help solve the puzzle – and possibly allow scientists to predict future earthquakes with greater accuracy.

Blow Sand Blow

Last October and November, a group of renowned archaeologists and paleoseismologists (geologists who study earthquakes) from as far away as Japan gathered at an unused MoDOT weigh-station site on southbound Interstate 55 near Steele, Mo., in Pemiscot County. Their mission was to examine evidence that could change scientific theory regarding the frequency of the great New Madrid quakes.

The scientists were participating in a cooperative program involving the Geological Survey of Japan, the U.S. Geological Survey, and the Center for Earthquake Research and Information at the University of Memphis. Their investigation was based upon artifacts and deposits formed by a sand blow, the sand and water that erupt to

the surface during an earthquake. The sand-blow evidence, discovered by MoDOT's cultural resources team, suggests that the window between big quakes, those over 7.5 magnitude, may be much shorter than previously thought: every 500 years instead of every 800-900 years.

"The most intense series of earthquakes ever recorded in the United States took place in the Missouri Bootheel, across the New Madrid Seismic Zone, over a period of several months in the winter of 1811-1812," says MoDOT Archaeologist Russell Weisman.

used as a borrow site for an upcoming transportation project. A borrow site supplies dirt for another project, usually within the same county, and usually from existing state right of way. Cultural resources specialists examine borrow sites, new right-of-way purchases and other places where ground will be disturbed for transportation improvement projects to make sure archeological sites, historic buildings, significant bridges and other resources will not be disturbed.

"Since the area where the weigh station once stood was already state property, it made great sense to borrow the dirt from this location to help with our upcoming project to resurface 15 miles of southbound I-55 in Pemiscot County," says MoDOT Transportation Project Manager Eric Krapf. "It saved everyone time and money."

Sand blows are very common in and around the Steele area, Weisman notes.

"Preliminary analysis of the artifacts recovered from beneath this sand blow, and a radiocarbon date on wood from an ancient posthole above it, suggest that the major earthquake that took place at this location was not the result of the 1811-1812 event, but from an earlier quake that occurred around 1450," he says.

MoDOT archaeologist Russell Weisman watches as excavators dig a trench to set the limits of the archaeological site.

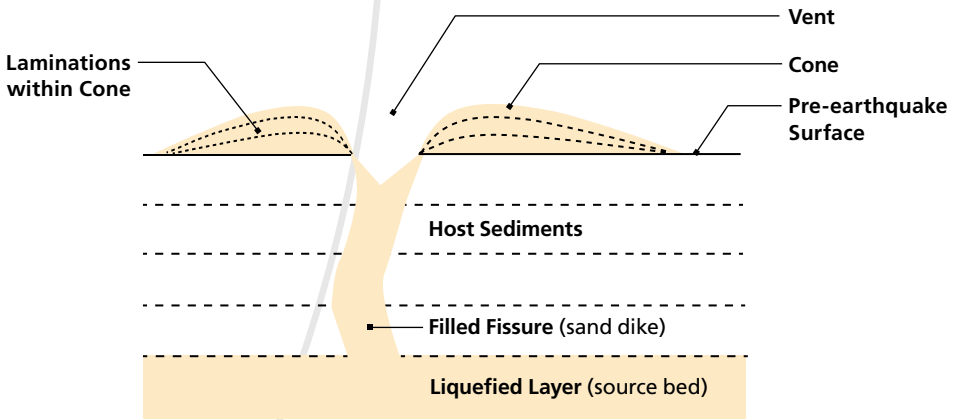
The trench reveals a 500-year-old sand blow, and archaeologists discover artifacts to prove Indians occupied, then left, the site.

The vibrations were so extreme that people in cities as far away as Pittsburgh Pa., and Norfolk, Va., were awakened from their sleep.

"During this period, the area experienced three quakes estimated to have been of eight or greater magnitude," Weisman says. "These events raise serious questions about when the region's next large quake will occur and how often the quakes can be expected."

Unearthing the Evidence

MoDOT's cultural resources team uncovered the sand blow while determining if the Steele weigh-station property could be



Cross-section of a sand blow
Source: Sims and Garvin, 1995

PHOTOGRAPH AT LEFT BY MIKE SCHURKE; RIGHT BY TONYA WELLS

Estimates on the age of the artifacts are being verified with additional radiocarbon dating. The findings then will be used to help refine the earthquake chronology.

International Attention

The discoveries by Weisman and his team attracted the attention of Dr. Martitia (Tish) Tuttle of Georgetown, Maine, whose research specialty is paleoseismology. She has an ongoing U.S. Geological Survey research grant to study the earthquake history of the New Madrid Seismic Zone of Southeast Missouri, Northeast Arkansas and neighboring parts of Tennessee, Kentucky and Illinois.

Pottery shards found at the I-55 weigh station, dating from 1300 to 1500.

Dr. Tuttle and Japanese seismologists examine archaeological features on a sand blow's surface.

Japanese paleoseismologists Koichi Shimokawa, Keita Takada and Dr. Kenji Satake, one of the world's leading experts in earthquake geology, joined Tuttle and other noted earthquake experts at the Steele site last October to document the sand blow and collect samples for dating and soil analysis.

"This location is of great interest to me since it looks to contain key evidence that could help refine the magnitude estimates of the 1450 earthquakes," Tuttle says. She plans to make a presentation at the American Geophysical Union in San Francisco on the use of soil resistivity and other geophysical techniques to locate and map the extent of sand blows at the weigh station and other study sites in the New Madrid Seismic Zone.

What The Evidence Means

The research conducted by Tuttle and her colleagues indicates that sequences of very large quakes also occurred around the years 900 and 1450. There is additional evidence

They Dig School!

By Pam Droog

The beautiful fall day was perfect for an archaeological dig. But before any ground was broken, fourth and fifth graders at the Instructional Resource Center in Jefferson City learned the fine points from two experts: MoDOT Archaeology Laboratory Specialist Jeff Berna and Archaeology Assistant Aaron Anglen.

Berna displayed and discussed actual artifacts recovered by MoDOT archaeologists from highway construction projects. He showed the children pottery, arrowheads and bones from an ancient Indian village as well as everyday items their great-grandparents may have used around the farm.

Over at the dig site, previously gridded with orange string, Anglen explained how archaeologists excavate and recreate a historic site.

It's all part of the job for Berna and Anglen, who, when they're not out digging artifacts prior to highway construction, are out discussing archaeology at schools, civic and professional organizations, career fairs, festivals and other events around Missouri.

Archaeology Laboratory Specialist Jeff Berna shows Indian pottery retrieved from a MoDOT construction project to students at the Instructional Resource Center in Jefferson City.

"Outreach is a big part of what we do," Berna says. "We really enjoy the hands-on demonstrations."

Fall's the busiest time for the pair's outreach activities.

"That's when most schools teach about native peoples, then move on to the colonists, pioneers and so on," Berna says. He and Anglen work closely with teachers to tailor their presentations to the history, science or other subject the class is studying.

Whatever the topic, arrows and arrowheads always attract an audience, Berna says, especially when he demonstrates how they were made.

At the weigh station site, Dr. Tuttle studies a sandblow formed during a massive earthquake about 500 years ago.

pointing to even earlier events, but the timing is still under study.

"From the earthquake chronology we have developed, we estimate that New Madrid-type events occur every 500 years on average," Tuttle says. "This information has been incorporated into the U.S. Geological Survey's National Earthquake Hazard Map, which is an important source of information for engineering companies, the insurance industry and planning boards."

Her research also has implications for bridge and highway design and engineering.

For example, several years ago, Tuttle and her colleagues discovered earthquake-induced sand blows along the Meramec River near I-55 in Arnold, Mo.

"MoDOT and University of Missouri-Rolla engineers are performing research there that may lead to further understanding of the source and magnitude of the earthquake event associated with this paloeoliquefaction site, which may impact future design in the region," says Thomas Fennessey, senior materials engineer at MoDOT.

"Our work on the Steele project has been a great opportunity to participate in important interdisciplinary and collaborative research," Weisman says. "Since the majority of America's prehistoric past is buried, important findings can be made today as a result of careful excavation and keeping an open and prepared mind."

The archeological site will be kept intact for future excavations planned for later this year. ■

Angela Wilson is public affairs manager for MoDOT's Southeast District.

Kids' thank-you notes to MoDOT archaeologists resemble actual artifacts.

Students dig for artifacts using techniques they learned from MoDOT archaeologists.

"Kids get a kick out of seeing how the Indians could turn a big, ugly rock into a fine tool," he says.

MoDOT is responsible for most of the archaeology in Missouri, since many universities have reduced funding. In fact, the cultural resources team is busier than ever, Berna says, due to highway projects accelerated by bond financing.

The team springs into action whenever important cultural resources may be threatened by transportation projects. A series of federal laws and regulations require MoDOT to attempt to preserve those resources.

Any artifacts found at a dig site are identified and sent to a curation facility at the University of Missouri-Columbia where they are available for researchers. One job could produce 10,000 or more artifacts, Berna explains.

"People are surprised to hear about MoDOT's cultural resources team, but they're also interested in their local history," Anglen says. "They love to see us out there digging."

Meanwhile, back at the school dig, students uncovered artifacts from an "alien culture." The chairs, bones, toys and more had been buried four years earlier. Thanks to information from Berna and Anglen, the students knew how to identify, measure, sketch, bag and tag the items, and gain insight into the mysterious civilization.

They also realized that archaeologists don't have to travel to exotic, ancient sites. They can perform valuable work right here in Missouri.

Pam Droog is editor of Pathways and a public affairs specialist at MoDOT General Headquarters.

PHOTOGRAPH AT BOTTOM BY MIKE WRIGHT; TOP BY RUSSELL WEISMAN